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Citation for published version:

Ademuyiwa, AO, Bekele, A, Berhe, AB, Borgstein, E, Capo-Chichi, N, Derbew, M, Evans, FM, Feyssa, MD, Galukande, M, Gawande, AA, Gueye, SM, Harrison, E, Jani, P, Kaseje, N, Litswa, L, Mammo, TN, Mellin-Olsen, J, Muguti, G, Nabukenya, MT, Ngoga, E, Ntirenganya, F, Rulisa, S, Starr, N, Tabiri, S, Tadesse, M, Walker, I, Weiser, TG & Wren, SM 2020, 'COVID-19 Preparedness within the Surgical, Obstetric and Anesthetic Ecosystem in Sub Saharan Africa', *Annals of Surgery*.
<https://doi.org/10.1097/SLA.0000000000003964>

Digital Object Identifier (DOI):

[10.1097/SLA.0000000000003964](https://doi.org/10.1097/SLA.0000000000003964)

Link:

[Link to publication record in Edinburgh Research Explorer](#)

Document Version:

Peer reviewed version

Published In:

Annals of Surgery

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COVID-19 preparedness within the surgical, obstetric and anesthetic ecosystem in Sub Saharan Africa

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Keywords: COVID-19, surgical ecosystem, anesthesia, obstetrics, low and middle income countries, preparation

Community transmission of COVID-19 is already being reported in Africa (1). Most countries on the continent will have 10,000+ confirmed cases within the month (2). The population, while generally younger than in Europe and North America, has much higher rates of poverty, malnutrition, HIV, and TB, which could shift the demographics of lethality. For surgeons, obstetricians, and anesthesiologists, the major challenge will be maintaining provision of emergency and essential surgery and obstetric care while preserving precious resources, minimizing exposure of health care workers, and preventing onward transmission (Table) (3). The human skill sets, resources, and supply chains supporting surgical services are also those needed for responding to the crisis (4)(5).

1. Develop a clear plan for providing essential operations during the pandemic.

The capacity to care for surgical and obstetric emergencies must be preserved. Many facilities have already postponed elective operations to conserve vital resources, but this approach is not as applicable as in high-income countries. Operations in the region are frequently for high-risk cancers or highly symptomatic patients, for which current guidance is not to postpone. The surgical burden is already high, and limitations on services will exacerbate waiting lists and sacrifice essential care.

Truly elective operations should, however, be postponed immediately to preserve the health and wellbeing of surgical, anesthetic, nursing, and cleaning staff. These providers will be important resources during a surge response. Many providers rely on elective and private work for their financial well-being, thus postponing elective surgery may work against their financial incentives. However, improved health worker and patient safety through reduced transmission is a compelling enough argument. To facilitate decision making and avoid conflicts, a triage

algorithm needs to be established and enforced, such as that proposed by the American College of Surgeons: <https://www.facs.org/about-acscovid-19/information-for-surgeons/triage>.

Patients should be kept geographically separate from COVID+ patients and discharged expeditiously to minimize nosocomial transmission (6)(7)(8). If case burden is high, consider dedicating one OR to COVID+ operations only (ideally with neutral or negative pressure) (9). This should be emptied of all non-essential materials and equipment. No unnecessary items should be brought into the operating room, including personal items such as mobile phones and pens. Personal linens and coverings such as cloth masks and bonnets should be washed at least daily, and probably more often when treating COVID+ patients.

2. Decrease exposure of health care staff as much as practicable and prevent nosocomial transmission to other patients and personnel.

While few staff are adequately trained in the appropriate use and application of personal protective equipment (PPE), perioperative personnel are at an advantage given their familiarity with maintaining sterility. Staff should receive training in appropriate donning and doffing techniques through simulation and videos (without using precious resources). Clear instructional posters for PPE donning/doffing should be prominently displayed, and the use of two providers should be encouraged to allow one person to observe and coach the other through the steps of the routine: www.cdc.gov/hai/pdfs/ppe/ppe-sequence.pdf (10)(11)(12)(13)(14)(15). Hand hygiene is critical, and 70% alcohol-based hand rub should be made widely available:

https://www.who.int/gpsc/5may/Guide_to_Local_Production.pdf. Symptomatic workers should not provide patient care but rather self-isolate, and testing of these workers should be prioritized.

Limiting unnecessary patient, family, and health worker movement through the hospital decreases the introduction and transmission of disease. When not essential, keep surgical and anesthetic staff out of hospital to preserve human resources. Trainees and students, in particular, should not be involved with known COVID+ cases unnecessarily. For usual care routines, including patient encounters, plain surgical masks can lower rates of health care worker infections and are recommended (16)(17)(18). Ancillary staff such as OR cleaners, instrument reprocessing staff and laundry personnel should take appropriate precautions and wear full PPE (goggles or face shield, surgical mask, heavy duty gloves, long sleeved gown, boots) (5). No special decontamination methods other than machine laundering with detergent are required for laundering linens; all surface areas should be disinfected with 0.5% chlorine or 70% alcohol solutions.

Patients with known or suspected COVID-19 should wear surgical masks when being transported through hospital spaces or in rooms without negative pressure isolation (19)(20)(21). Intubation is an aerosolizing procedure and should be performed by the most skilled provider available wearing an N95 or KN95 mask. *Only absolutely essential staff* should be present during intubation, and IV rapid sequence induction without bag mask ventilation is preferred (22). When appropriate and safe, consider regional anesthesia with IV sedation to reduce aerosols. Whenever practicable, decrease case duration and limit aerosol-generating maneuvers (such as the free release of pneumoperitoneum during laparoscopy). Patients should be recovered in the OR, and prior to transport an advance runner sent to clear the path. Consider using a Checklist to ensure appropriate precautions are taken for operations with suspected or known COVID-19 patients (Figure)(7).

Viral filters and appropriate circuit cleaning measures are essential and should be reviewed (6)(23), otherwise ventilation mechanics may disseminate aerosols throughout an ICU. If single-use plastic anesthesia or surgical equipment (endotracheal tubes, ventilator circuit tubing, plastic suction tubing, electrocautery handpieces) must be reused, ensure that disinfection aiming for “high-level disinfection” or “sterility” is employed, including immersion in appropriate concentration glutaraldehyde, phenol, or hydrogen peroxide solution (7)(20)(24).

Surfaces in the OR should be thoroughly cleaned between cases, including pulse oximeter probes, thermometers, blood pressure cuffs and other reusable materials; SARS-CoV-19 is rapidly killed with 70% alcohol solution or 0.5% chlorine solution (5)(25). Using clear plastic sheets (cleaned or changed in between patients) to cover the anesthesia machine, the monitors, and the patient's face during aerosol-producing maneuvers like intubation and extubation, could provide additional protection.

3. Conserve PPE and consumables.

Manufacturers are already filling backorders from high-income countries; this will additionally stress supply chains to Africa. Familiarity with severe resource shortages may guide creative and innovative strategies to conserve and extend resources. Extended use of N95 masks (continuous wearing while seeing multiple patients) is preferred to limited reuse of N95 masks (doffing and redonning between patients) (26). N95 mask life may be lengthened by wearing a plastic face shield or a surgical mask over it. Use of chlorine or alcohol solution to sanitize N95 masks damages mask integrity; however heating to 70°C (160°F) in a dry oven for 30 minutes seems a promising solution to disrupt viral particles and maintain mask integrity for reuse (27)(28). Other

innovative solutions are being proposed, as in this example from Boston Children's Hospital: https://www.youtube.com/watch?v=Es_iY5WJdmI. While N95 masks are superior to surgical masks in protecting against aerosolized viral particles, surgical masks still afford significant protection over no mask (29)(30)(31).

Cloth attire in the form of scrub hats or bonnets should be washed between each use if possible, and no less than daily. If gowns are repurposed for isolation units, they should be washed after each prolonged care routine; consider wearing rubber aprons under such gowns. The protection afforded by cloth masks is not well studied but may be significantly less than surgical masks and is not protective to the same extent as N95 respirators; it should be used as a last option only (5) (29)(32)(33)(34)(35)(36).

4. Plan for strategic repurposing of ORs, recovery areas, and staff for managing COVID-19 cases.

The commandeering of ORs for use as ICUs, which has been proposed in many high-resource settings, must be done with extreme caution. Emergency surgery capacities should not be compromised by taking up all available OR space and anesthetic machines with COVID+ patients. As the average reported time spent on mechanical ventilation has been up to 13 days (37)(38), critical resources and space will be occupied for weeks to months and will be difficult to reclaim once repurposed.

Guidance and training should be provided *immediately* to make best use of the technical and clinical skills of all perioperative personnel – waiting until caseloads increase will unduly delay preparations. Hospitals, professional societies, and ministries of health should provide physician

and nursing staff with basic ICU and ventilator management refresher education to improve their skill sets; SAGES and the Faculty of Intensive Care Medicine have recently provided such resources: <https://www.sages.org/basics-of-mechanical-ventilation-for-non-critical-care-mds/> and <https://icmanaesthesiacovid-19.org/clinical-guidance>.

5. Maintain and support staff wellness while assisting with difficult ethical considerations in resource management.

Doctors, nurses, cleaners, and other hospital support staff have significant anxieties that must be acknowledged and managed. The fears of transmitting to family or becoming infected oneself, the increase in work hours, and the need for childcare coverage are real. Furthermore, providers may be understandably nervous about providing care outside of their normal scope of practice or working beyond their area of competence. Leadership can help by providing information in a transparent way, expressing gratitude for the commitment to patients and colleagues, and offering reassurance that the system will help protect them and support them and their family.

As ventilators will be critically inadequate, there will be additional emotional distress when allocating resources and denying care to patients. Facilities should create a committee and utilize standardized risk assessments to determine allocation decisions in advance. The burden of decision making should not be placed on the frontline health care workers, nor made ad hoc at the bedside. There are multiple resources for guiding the complex decision making in resource allocation and rationing in pandemic situations (39)(40)(41)(42)(43)(44). A recent ethical framework made the following priority recommendations(45)(46), amongst others: 1. Aim to both save the most lives and most years of life, giving priority to maximizing the number of patients that survive treatment (maximizing benefit); 2. Critical testing, PPE, ICU beds, therapeutics, and vaccines should go first to front line health care workers and others who keep

critical infrastructure functioning due to their instrumental value in the pandemic response and difficulty of replacing (instrumental value); and 3. Avoid first-come first serve approaches and use random allocation such as a lottery instead (equality). The Hastings Center has provided a freely available online resource that is helpful to guide an ethics process:

<https://www.thehastingscenter.org/ethicalframeworkcovid19/>.

Communication will be critical, and an effective communication plan within and between facilities, as well as between providers across the health system and even between countries, is essential and should be established immediately. A task force that can oversee this dynamic situation and provide additional guidance and interpretation of directives (from ministries or multinational organizations such as the World Health Organization) can be extremely valuable. A useful tool for health system organization is the Incident Command System (ICS), a standardized hierarchical structure that enables a cooperative response and organizes and coordinates activities; online ICS training is available for free:

<https://emilms.fema.gov/IS0700b/curriculum/1.html>.

Much will be asked of us all in the coming weeks and months, and we may well find ourselves stretched and beyond our comfort zones. We will be remembered for our actions, and how we comported ourselves in the midst of this pandemic. Our most valuable talents – our compassion, our empathy, and our words of comfort – must be dispensed liberally, as they are both free and priceless.

References:

1. World Health Organization: Coronavirus disease 2019 (COVID-19) Situation Report - 71 [Internet]. [cited 2020 Apr 1]. Available from: https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200331-sitrep-71-covid-19.pdf?sfvrsn=4360e92b_6
2. Pearson CAB, et al. Projection of early spread of COVID-19 in Africa as of 25 March 2020. Centre for Mathematical Modelling of Infectious Diseases; [cited 2020 Apr 1] available from: https://cmmid.github.io/topics/covid19/current-patterns-transmission/reports/COVID10k_Africa.pdf.
3. Spinelli A, Pellino G. COVID-19 pandemic: perspectives on an unfolding crisis. BJS [cited 2020 Mar 24];n/a(n/a). Available from: <https://bjssjournals.onlinelibrary.wiley.com/doi/abs/10.1002/bjs.11627>
4. Brindle M, Gawande A. Managing COVID-19 in Surgical Systems. Ann Surg 2020 [epub ahead of print]: <https://journals.lww.com/annalsofsurgery/Documents/Managing%20COVID%20in%20Surgical%20Systems%20v2.pdf>
5. Partners In Health: COVID-19 Clinical Response [cited 2020 Mar 21]. Available from: <https://www.pih.org/covid-response>
6. Wen X, Li Y. Anesthesia Procedure of Emergency Operation for Patients with Suspected or Confirmed COVID-19. Surg Infect. 2020 Feb 25;
7. Ti LK, Ang LS, Foong TW, Ng BSW. What we do when a COVID-19 patient needs an operation: operating room preparation and guidance. Can J Anesth 2020 Mar 6 [cited 2020 Mar 20]; Available from: <https://doi.org/10.1007/s12630-020-01617-4>
8. Wong J, Goh QY, Tan Z, Lie SA, Tay YC, Ng SY, et al. Preparing for a COVID-19 pandemic: a review of operating room outbreak response measures in a large tertiary hospital in Singapore. Can J Anesth 2020 Mar 11 [cited 2020 Mar 21]; Available from: <https://doi.org/10.1007/s12630-020-01620-9>
9. Alhazzani, Waleed. Surviving Sepsis Campaign: Guidelines on the Management of Critically Ill Adults with Coronavirus Disease 2019 (COVID-19). Crit Care Med. [epub ahead of print]: <https://www.sccm.org/SurvivingSepsisCampaign/Guidelines/COVID-19>.
10. Personal protective equipment: Our process if COVID-19 is suspected | The Loop [Internet]. [cited 2020 Mar 21]. Available from: <https://medcom.uiowa.edu/theloop/news/personal-protective-equipment-our-process-if-covid-19-is-suspected>

11. Hon C-Y, Gamage B, Bryce EA, LoChang J, Yassi A, Maultsaid D, et al. Personal protective equipment in health care: Can online infection control courses transfer knowledge and improve proper selection and use? *Am J Infect Control*. 2008 Dec 1;36(10):e33–7.
12. Lim SM, Cha WC, Chae MK, Jo IJ. Contamination during doffing of personal protective equipment by healthcare providers. *Clin Exp Emerg Med*. 2015 Sep 30;2(3):162–7.
13. Chughtai AA, Chen X, Macintyre CR. Risk of self-contamination during doffing of personal protective equipment. *Am J Infect Control*. 2018 Dec 1;46(12):1329–34.
14. Otter JA, Donskey C, Yezli S, Douthwaite S, Goldenberg SD, Weber DJ. Transmission of SARS and MERS coronaviruses and influenza virus in healthcare settings: the possible role of dry surface contamination. *J Hosp Infect*. 2016 Mar 1;92(3):235–50.
15. Centers for Disease Control and Prevention: PPE Donning and Doffing Sequence [Internet]. [cited 2020 Mar 21]. Available from: <https://www.cdc.gov/hai/pdfs/ppe/ppe-sequence.pdf>
16. Poston JT, Patel BK, Davis AM. Management of Critically Ill Adults With COVID-19. *JAMA* 2020 Mar 26 [cited 2020 Mar 26]; Available from: <http://jamanetwork.com/journals/jama/fullarticle/2763879>
17. Ng, Kangqi; Poon, Beng Hoong. COVID-19 and the Risk to Health Care Workers: A Case Report. *Ann Intern Med* [Internet]. 2020 Mar 16 [cited 2020 Mar 26]; Available from: <https://annals.org/aim/fullarticle/2763329/covid-19-risk-health-care-workers-case-report>
18. Smith JD, MacDougall CC, Johnstone J, Copes RA, Schwartz B, Garber GE. Effectiveness of N95 respirators versus surgical masks in protecting health care workers from acute respiratory infection: a systematic review and meta-analysis. *CMAJ*. 2016 May 17;188(8):567–74.
19. Chen C-C, Willeke K. Aerosol penetration through surgical masks. *Am J Infect Control*. 1992 Aug 1;20(4):177–84.
20. Rowley E, Dingwall R. The use of single-use devices in anaesthesia: balancing the risks to patient safety. *Anaesthesia*. 2007;62(6):569–74.
21. Milton DK, Fabian MP, Cowling BJ, Grantham ML, McDevitt JJ. Influenza Virus Aerosols in Human Exhaled Breath: Particle Size, Culturability, and Effect of Surgical Masks. *PLoS Pathog* [Internet]. 2013 Mar 7 [cited 2020 Mar 20];9(3). Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3591312/>
22. World Federation Of Societies of Anaesthesiologists - Coronavirus [Internet]. [cited 2020 Mar 23]. Available from: <https://www.wfsahq.org/resources/coronavirus>

23. Anesthesia Patient Safety Foundation. FAQ on Anesthesia Machine Use, Protection, and Decontamination During the COVID-19 Pandemic [Internet]. [cited 2020 Mar 20]. Available from: <https://www.apsf.org/faq-on-anesthesia-machine-use-protection-and-decontamination-during-the-covid-19-pandemic/>
24. Rutala WA, Weber DJ. Disinfection, sterilization, and antisepsis: An overview. *Am J Infect Control*. 2019;47S:A3–9.
25. World Health Organization. Water, sanitation, hygiene and waste management for the COVID-19 virus [Internet]. 2020 [cited 2020 Mar 21]. Available from: <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/technical-guidance/infection-prevention-and-control>.
26. Fisher EM, Shaffer RE. Considerations for Recommending Extended Use and Limited Reuse of Filtering Facepiece Respirators in Health Care Settings. *J Occup Environ Hyg*. 2014 Aug 3;11(8):D115–28.
27. Cui Y. Can Facial Masks be disinfected for re-use? Personal Communication: Department of Materials Science and Engineering, Stanford University. McCullough Building, Room 343 476 Lomita Mall Stanford, CA 94305 USA; 2020.
28. University of Tennessee Research Foundation. Information and FAQs on Performance, Protection, and Sterilization of Masks Against COVID-19 [Internet]. 2020 [cited 2020 Mar 26]. Available from: <https://utrf.tennessee.edu/information-faqs-performance-protection-sterilization-of-masks-against-covid-19/>
29. Centers for Disease Control and Prevention. Strategies for Optimizing the Supply of N95 Respirators [Internet]. 2020 [cited 2020 Mar 21]. Available from: <https://www.cdc.gov/coronavirus/2019-ncov/hcp/respirators-strategy/index.html>
30. Makison Booth C, Clayton M, Crook B, Gawn JM. Effectiveness of surgical masks against influenza bioaerosols. *J Hosp Infect*. 2013 May 1;84(1):22–6.
31. Centers for Disease Control and Prevention. Coronavirus Disease 2019 (COVID-19) [Internet]. 2020 [cited 2020 Mar 23]. Available from: <https://www.cdc.gov/coronavirus/2019-ncov/hcp/ppe-strategy/face-masks.html>
32. MacIntyre CR, Seale H, Dung TC, Hien NT, Nga PT, Chughtai AA, et al. A cluster randomised trial of cloth masks compared with medical masks in healthcare workers. *BMJ Open*. 2015 Apr 1;5(4):e006577.
33. Rengasamy S, Eimer B, Shaffer RE. Simple Respiratory Protection—Evaluation of the Filtration Performance of Cloth Masks and Common Fabric Materials Against 20–1000 nm Size Particles. *Ann Occup Hyg*. 2010 Oct 1;54(7):789–98.

34. Davies A, Thompson K-A, Giri K, Kafatos G, Walker J, Bennett A. Testing the Efficacy of Homemade Masks: Would They Protect in an Influenza Pandemic? *Disaster Med Public Health Prep.* 2013 Aug;7(4):413–8.
35. Dato VM, Hostler D, Hahn ME. Simple Respiratory Mask. *Emerg Infect Dis.* 2006 Jun;12(6):1033–4.
36. van der Sande M, Teunis P, Sabel R. Professional and Home-Made Face Masks Reduce Exposure to Respiratory Infections among the General Population. *PLoS ONE* [Internet]. 2008 Jul 9 [cited 2020 Mar 22];3(7). Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2440799/>
37. Arentz M, Yim E, Klaff L, Lokhandwala S, Riedo FX, Chong M, et al. Characteristics and Outcomes of 21 Critically Ill Patients With COVID-19 in Washington State. *JAMA.* 2020 Mar 19;
38. Wujtewicz M, Dylczyk-Sommer A, Aszkiełowicz A, Zdanowski S, Piwowarczyk S, Owczuk R. COVID-19 - what should anaesthesiologists and intensivists know about it? *Anaesthesiol Intensive Ther.* 2020 Mar 20;
39. Powell T, Christ KC, Birkhead GS. Allocation of Ventilators in a Public Health Disaster. *Disaster Med Public Health Prep.* 2008 Mar;2(1):20–6.
40. Fink SL. Worst case: rethinking tertiary triage protocols in pandemics and other health emergencies. *Crit Care.* 2010 Jan 21;14(1):103.
41. Patrone D, Resnik D. Pandemic Ventilator Rationing and Appeals Processes. *Health Care Anal.* 2011 Jun 1;19(2):165–79.
42. Vawter DE, Garrett JE, Prehn AW, Gervais KG. Health Care Workers' Willingness to Work in a Pandemic. *Am J Bioeth.* 2008 Sep 23;8(8):21–3.
43. Lin JY, Anderson-Shaw L. Rationing of Resources: Ethical Issues in Disasters and Epidemic Situations. *Prehospital Disaster Med.* 2009 Jun;24(3):215–21.
44. Howes D, Tsai E. Ventilator Allocation In A Pandemic: Discussion And A Model For Rationing Restricted Resources. *WebMed Central.* 2010 Dec 3 [cited 2020 Mar 20]; Available from: http://www.webmedcentral.com/article_view/1258
45. Vawter D, Garrett J, Gervais K, Prehn A, Debruin D, Tauer C, et al. For the good of us all: Ethically rationing health resources in Minnesota in a severe influenza pandemic. *Minnesota Pandemic Ethics Project Report.* 2010 [cited 2020 Apr 1]; Available from: <https://www.health.state.mn.us/communities/ep/surge/crisis/ethics.pdf>
46. Emanuel EJ, Persad G, Upshur R, Thome B, Parker M, Glickman A, et al. Fair Allocation of Scarce Medical Resources in the Time of Covid-19. *N Engl J Med.* 2020 Mar 23;

Figure: Perioperative Checklist for operations on confirmed or suspected patients with COVID-19

COVID-19 Patient & Health Care Worker Safety Checklist

*To be used in conjunction with WHO Surgical Safety Checklist

Before patient arrives in operating room

To Nursing Team:

COVID or Infection Prevention team notified?

COVID Notification tags placed on door

All non-essential equipment & supplies removed from Operating Room

Communication plan to request materials needed in OR?

Mobile phone communication

Extra staff assigned

Other

Planned postoperative isolation prepared:

Ward ICU

Assemble needed materials for operation:

PPE available for OR

Viricidal spray/wipes available?

(Once complete nurse can bring anticipated supplies needed into OR)

To Anesthesia Provider:

Drugs and intubation equipment assembled and ready?

Yes No

Is the pulse oximeter available and functioning?

Yes No

Once patient in operating room

To Anesthetist: Pre Intubation*

All non-essential personnel leave room

Anesthetist dons N95 mask for aerosolizing procedure

Viral filter on anesthesia circuit

If not intubated, patient wears mask throughout case

To Nursing Team:

External Runner designated to stay outside OR

If additional supplies needed, they are called for by phone and delivered to door of OR

Patient trolley wiped with 0.5% chlorine or 70% alcohol solution

To Surgeon:

Minimize duration of surgery

Minimize aerosolization

Only essential assistance - no trainees or students if possible

Perform WHO Surgical Safety Checklist

End of operation

Transport team activated

Specimen Handling:

All specimens double bagged

Porter wears gloves for transport

To Anesthetist:

Patient extubated and recovers in OR

Final postoperative isolation:

Ward ICU

After patient leaves operating room

Removal of PPE:

In OR: Remove shoe cover, gowns, gloves

Outside OR: Remove N95, goggles, cap

Bag N95 for reprocessing if needed (70°C dry heat for 30 minutes)

Clean goggles/face shield with 70% alcohol

Perform hand hygiene, change scrubs

Waste Management:

All unused materials from OR double bagged in plastic bag for disposal

Spray waste bags with viricidal

Transport wears gloves to deliver trash to waste receptacle or incinerator

Operating Room Disinfection:

Clean all surfaces (OR table, stools, equipment) - 0.5% chlorine or 70% alcohol

Clean floor with 0.5% chlorine

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Table: Recommendations for COVID-19 preparedness within the surgical, obstetric, and anesthetic ecosystem in Sub-Saharan Africa

1	Develop a clear plan for essential operations during pandemic	<ul style="list-style-type: none"> ○ Preserve hospital capacity to care for surgical and obstetric emergencies ○ Postpone truly elective operations to preserve PPE, staff and facility capacity ○ Adapting algorithms to categorize cases as elective, urgent or emergent, and enforce them ○ Trial nonoperative management of patient conditions when safe for patients ○ Keep COVID+ patients geographically separate from other surgical patients ○ Consider dedicating one operating room for COVID+ patient use only if case burden is high ○ Operating rooms used for COVID+ patients should be kept at neutral or negative pressure
2	Limit exposure of health care staff and prevent hospital transmission of SARS-CoV-19	<ul style="list-style-type: none"> ○ Train staff on appropriate donning and doffing of PPE ○ Encourage simulation and using two providers for donning/doffing procedures ○ Limit unnecessary patient and physician movement through the hospital, limit visitors ○ Avoid involving students and trainees in patient care of COVID+ patients when possible ○ Minimize the staff required in the hospital to preserve human resources ○ All staff including cleaners, laundry personnel and others should be provided with appropriate PPE ○ Use surgical masks when caring for COVID-19 suspected or infected patients ○ Launder all contaminated linens with detergent regularly ○ Disinfect all hard surface areas regularly with 0.5% chlorine or 70% alcohol solution ○ Enforce frequent and proper handwashing practices - Alcohol-based hand rub can be locally manufactured easily and inexpensively ○ Develop care protocols and teams specifically for COVID response ○ Consider establishing a COVID+ only operating room to be cleared of all materials ○ Minimize aerosols during anesthesia: use regional anesthesia when possible, most senior provider should attempt intubation, only absolutely essential personnel in OR during intubation, recover patients in OR ○ Limit case duration, limit aerosolization during laparoscopy ○ Consider use of COVID checklist for suspected/known COVID patients undergoing surgery ○ If reprocessing single use plastic materials, achieve high-level disinfection or sterilization
3	Conserve PPE	<ul style="list-style-type: none"> ○ Develop a clear understanding of current stocks and supply

	and consumables	<p>chains</p> <ul style="list-style-type: none"> ○ Airborne precautions (N95 or PAPR) only required during aerosolizing procedures (intubation, bronchoscopy, NIPPV, high flow nasal cannula oxygen, nebulized medication administration) ○ Use droplet & contact precautions (surgical mask, eye protection, gown, gloves) for other patient encounters with suspected or known COVID patient. ○ Extended use of N95 masks is preferred to reuse of the same mask ○ N95 mask contamination may be reduced by covering with plastic face shield or surgical mask ○ Do not decontaminate N95 respirators with chlorine or alcohol solution ○ If severe shortage, consider reprocessing N95 masks in 70°C oven for 30 minutes ○ Wash reusable PPE (cloth hats, gowns, etc) between each use <p>Cloth masks should be used as a last option only and provide little protection against droplet or airborne particles</p>
4	Plan to expand critical care and repurpose staff	<ul style="list-style-type: none"> ○ Carefully consider if/how many ORs or PACUs could be repurposed for critical care needs ○ Prepare providers to work outside their usual scope of practice ○ Provide refresher trainings on ventilator management, critical care, and COVID-specific care guidelines to providers who may be asked to work in different areas
5	Support staff wellness while assisting with difficult ethical considerations	<ul style="list-style-type: none"> ○ Provide material and psychological resources to staff during this time of crisis ○ Consider how needs such as HCW home isolation, child care, meal preparation, or general stress management can be supported by hospital leadership ○ Develop a plan in advance for managing resource shortages and determining scarce resource allocation ○ Frontline healthcare workers should not have to make resource allocation decisions alone ○ Provide compassion, empathy and respect for patients, family members, and healthcare workers in this time of crisis